

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2003-261890

(43)Date of publication of application : 19.09.2003

(51)Int.Cl.

C10L 9/10
C10L 1/12
C10L 1/14
F23G 5/02
F23J 7/00

(21)Application number : 2002-066513

(71)Applicant : TAIHO IND CO LTD

(22)Date of filing : 12.03.2002

(72)Inventor : ONOZAWA MITSUO
NAKAI SHIGERU
IMOTO YOSHIMI

(54) FUEL ADDITIVE FOR SLAGGING PREVENTION AND METHOD FOR BURNING FUEL

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a fuel additive which prevents slagging caused by ash contained in a fuel when the fuel, especially one having a high ash content such as coal or oil coke, is burned; and a method for burning a fuel by using the additive.

SOLUTION: The fuel additive is a composition prepared by dispersing, in water and/or oil, 10-60 wt.% at least one powdery compound having a particle size of 0.1-10 μm and selected from among an Mg compound, an Si compound, and an Fe compound, 5-40 wt.% superfine particulate silica compound having a particle size of 3-200 nm, and an alkali metal compound (R=Na or K) in a concentration (in terms of R₂O) of 0.02-2.5 wt.%. The additive is added to a liquid or solid fuel before burning.

LEGAL STATUS

[Date of request for examination] 15.04.2002

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the
examiner's decision of rejection or application
converted registration]

[Date of final disposal for application]

[Patent number] 3746010

[Date of registration] 02.12.2005

* NOTICES *

JPO and INPIT are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] Fuel additive for slagging prevention characterized by consisting of 5 - 40 % of the weight of silica compounds of a kind of Mg compound of the shape of powder with a particle size of 0.1-10 micrometers, Si compound, and Fe compound or two or more sorts of 10 - 60 % of the weight, and the shape of an ultrafine particle with a particle size of 3-200nm, and a constituent which made water and/or an oil distribute 0.02 - 2.5 % of the weight by making an alkali-metal (R=Na, K) compound into R2O concentration.

[Claim 2] Fuel additive for slagging prevention according to claim 1 whose alkali-metal (R=Na, K) compound is a kind of water glass, such as a specific silicate and a potassium silicate, a sodium hydroxide, a potassium hydroxide, a carbonate compound, the alkali-metal salt of a chelate, a chelate metal and an alkali-metal salt, and an oil solubility alkali-metal salt, or two sorts or more.

[Claim 3] For 5 - 40 % of the weight, and an alkali-metal (R=Na, K) compound, the silica compound of the shape of an ultrafine particle with a particle size of 3-200nm is [kind of Mg compound of the shape of powder with a particle size of 0.1-10 micrometers, Si compound, and Fe compound, or two sorts or more / 0.02 - 2 % of the weight, and a surfactant] fuel additive for slagging prevention according to claim 1 or 2 with which it is 10 - 55 % of the weight, and is characterized by 10 or less % of the weight and the remainder being water and/or an oil as R2O concentration.

[Claim 4] The silica compound of the shape of an ultrafine particle with a particle size of 3-200nm is fuel additive for slagging prevention given in any 1 term of claims 1-3 characterized by being coating or the permuted silica which carried out aluminum denaturation or iron denaturation with aluminum compound or Fe compound about a silica simple substance and/or its whole front face, or its part.

[Claim 5] Fuel additive for slagging prevention given in any 1 term of claims 1-4 characterized by containing a kind of calcium compound of the shape of powder with a particle size of 0.1-10 micrometers, aluminum compound, and Zr compound, or two or more sorts of 25 % of the weight or less.

[Claim 6] The combustion method of the fuel characterized by adding and burning fuel additive according to claim 1 to 5 in a liquid fuel oil or solid fuel, or making it add and burn in a direct combustion ambient atmosphere.

[Claim 7] The combustion method of the fuel characterized by adding for coal and burning fuel additive according to claim 1 to 5 after grinding in front of a coal grinding process.

[Claim 8] The combustion method of the fuel according to claim 6 or 7 characterized by carrying out the intermittent bulk feed of the 1 - 50 weight section to the short time of 30 minutes - 2 hours respectively 1 to 5 times per day as ash content in fuel additive to the amount of scattering scales 100 weight section at the time of combustion resulting from the ash content contained in the fuel in the fuel additive making time.

[Translation done.]

* NOTICES *

JPO and INPIT are not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.**** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the combustion method of the fuel additive for slagging prevention which can prevent slagging which originates in the ash content in a fuel in the case of combustion of a fuel with much ash content represented by various fuels especially coal, oil coke, etc., and a fuel.

[0002]

[Description of the Prior Art] The clinker resulting from the ash content in a fuel and trash tending to produce the various incinerators which carry out incineration processing of the boiler which uses coal, an oil course, a byproduction oil, etc. as a fuel, a recovery boiler, various heating furnaces and various trash, the waste tire, etc., and starting slagging (lock out phenomenon) with these growth is known. Although spacing of a water pipe was extended or the policy which installs many soot blows was taken in the boiler etc. as the coping-with method for preventing these failures, also when continuation operation was able to be carried out only about one month with the content of ash content, such as a fuel, the generated melting point of ash content, it was still by crude-izing of a fuel, combustion fluctuation, fluctuation of a load, etc. That is, since slagging arose, the activity which suspends operation, cools the inside of a furnace and carries out the exfoliation omission of the clinker was required. Moreover, to these failures, the attempt which is going to control slagging is also examined by adding in a fuel the fuel additive which made water or an oil distribute Fe compound conventionally shown by alkaline-earth-metal compounds and $m\text{FeO} \cdot n\text{Fe}_2\text{O}_3$ (m and n are zero or more numbers), such as a magnesium hydroxide, magnesium acetate, a calcium hydroxide, a calcium carbonate, and a dolomite, or pouring in into combustion gas as indicated by JP,61-250416,A, JP,62-77508,A, etc.

[0003]

[Problem(s) to be Solved by the Invention] Said conventional fuel additive acts effectively to a fuel with comparatively little ash content. That is, slagging can be prevented by changing the property of water pipe adhesion ashes by hemisphere-temperature-of-ash lifting, ashy elasticity-izing, ashy black-ization, etc. However, a fuel with much ash content represented by coal and the water pipe adhesion ashes produced, for example when [with especially a low combustion hemisphere temperature of ash] it is made to these-burn with the Prima charcoal were abundant, and even if occasionally adhered to the water pipe and the waterwall firmly as an adhesive clinker, it absorbed fly ash further, it becomes easy to grow up a huge clinker and it added in the large quantity in said conventional fuel additive, it was difficult [it] to control slagging. And at a present stage, a means to prevent effectively slagging produced in case the fuel of such a lot of ash contents is burned is not found out.

[0004]

[Means for Solving the Problem] This invention is wholeheartedly obtained in view of the above after research. A kind of Mg compound of the shape of powder with a (A) particle size of 0.1-10 micrometers, Si compound, and Fe compound, or two or more sorts of 10 - 60 % of the weight, (B) 5 - 40 % of the weight of silica compounds of the shape of an ultrafine particle with a particle size of 3-200nm, (C) It is related with the fuel additive for slagging prevention characterized by consisting of a constituent which made water and/or an oil distribute 0.02 - 2.5 % of the weight by making an alkali-metal (R=Na, K) compound into R_2O concentration. A particle size here means the first [an average of] particle size, and it is only henceforth described as particle size.

[0005] Moreover, when the combustion method of the fuel characterized by for this invention adding and burning the above-mentioned fuel additive in a liquid fuel oil or solid fuel, or adding and burning it in a direct combustion ambient atmosphere and solid fuel are coal, the above-mentioned fuel additive is added for coal in front of a coal grinding process, and the combustion method of the fuel (coal) characterized by making it burn after grinding is also offered.

[0006] Furthermore, in the above-mentioned combustion method, it found out that the failure which originates in the ash content in a fuel more effectively could be prevented to the amount of scattering scales 100 weight section at the time of combustion resulting from the ash content contained in the fuel in the fuel additive making time by carrying out the intermittent bulk feed of the 1 - 50 weight section to the short time of 30 minutes - 2 hours respectively 1 to 5 times per day as ash content in fuel additive.

[0007] That is, this invention persons found out that the reinforcement of generation ashes was reduced and it could make it possible to be able to fail to scratch it easily by a soot blow etc. by burning a liquid fuel oil or solid fuel using the fuel additive of the specific presentation which combined powder with a particle size of 0.1-10 micrometers and a silica compound with a dramatically fine particle size. Furthermore, with combination with the combustion method which carries out abundant addition intensively for a short time which is not performed in the former, there was much ash content, such as coal, and it succeeded in preventing failures, such as slagging produced in case a fuel which occasionally contains the low ash content of a generation hemisphere temperature of ash is burned. As the result, it exfoliates, firm water pipe adhesion ashes and a huge clinker are easily, omitted in a soot blow etc., the rate of heat absorption to the heating surface is raised, a high temperature corrosion and dew point corrosion can be reduced further, generation of unburnt carbon, and SO₃ and NO_x can be made to be able to control, and stable operation of the operation of a boiler etc. can be carried out in the long run.

[0008]

[Embodiment of the Invention] The following can be used as Mg compound of the shape of powder with a particle size of 0.1-10 micrometers which is the (A) component used for this invention, Si compound, and a Fe compound.

Mg compound: A magnesium hydroxide, a magnesium carbonate, magnesium-oxide Si compound:silica (quartz) powder, natural quartz-sand powder, artificial quartz-sand powder, a kaolin, talc, diatom earth powder, baking diatom earth powder, clay (presentation SiO₂46%, 2O₃39% of aluminum), zirconium silicate Fe compound:rouge, a tri-iron tetraoxide, Synthetic Ochre (goethite)

[0009] Moreover, as for the thing which made water distribute especially the silica compound of the shape of an ultrafine particle with a particle size of 3-200nm which is the (B) component used for this invention (almost close to the dissolution), marketing is also carried out as a silica sol (colloidal silica). Moreover, slagging prevention effectiveness sufficient in what has a larger particle size than this range is not acquired, but it is 10-100nm in particle size more preferably.

[0010] Furthermore, the fuel additive of this invention can be made to porosity-ize the scale resulting from fuel ashes by containing an alkali-metal (R=Na, K) compound as a (C) component, and making 0.02 - 2.5 % of the weight contain as R₂O concentration while improving the adhesion to the water pipe and water pipe furnace wall of the above-mentioned (A) component or the (B) component. Moreover, although a commercial silica sol (colloidal silica) can be used as the above-mentioned (B) component when fuel additive is the emulsion (a W/O mold, O/W mold) of a water or water-oil In this commercial silica sol, the (C) component has already contained as an impurity, for example, for Na₂O, 0.01 - 0.7 % of the weight and K₂O are [as opposed to / in the case of synthetic colloidal silica / 220 - 50 % of the weight of SiO(s)] usually 0.1 or less % of the weight of ***** rare ***** . then -- as the (C) component -- water glass, such as silicate (a specific silicate, potassium silicate), and a hydroxide (a sodium hydroxide --) a potassium hydroxide and a carbonate compound (for example, a sodium carbonate and potassium carbonate --) a sodium hydrogencarbonate, a potassium hydrogencarbonate, and the alkali-metal salt (for example, H (2-0) and (2-4) Na of ethylenediaminetetraacetic acid (EDTA) --) of a chelate H-(2-4) K, and H (2-0) and (1-3) Na of nitrilotriacetic acid (NTA), (2-0) (2-0) H-(1-3) K, a chelate metal and an alkali-metal salt (for example, if divalent metal is set to M (II) and trivalent metal is set to M (III)) EDTA-M(II) and 2Na, EDTA-M (III) and Na, NTA-M(II) and Na, Although it newly adds and water-soluble matter, such as EDTA-M(II) and 2K, EDTA-M(III) andK, and NTA-M(II), K, is made into 0.02 - 2.5 % of the weight as R₂O concentration with the total quantity with an impurity into a commercial silica sol Since the adhesiveness of an additive component becomes strong too much and addition of an excessive amount also reduces an adhesion hemisphere temperature of ash, it is 0.1 - 1.5 % of the weight as R₂O concentration preferably. The alkali-metal (R=Na, K) compound which is this (C) component Silicate, When it is a kind of a hydroxide, a carbonate compound, the alkali-metal salt of a chelate, and a chelate metal and an alkali-metal salt, or two sorts or more It sets in the emulsion (W/O mold, O/W mold) system of a water or water-oil especially. It has the operation which improves the fluidity and distributed stability in mixing with the powder which is the aforementioned (A) component, and the silica sol (colloidal silica) which is the (B) component. For example, although it will become a gel hyperviscous water slurry from the shape of a paste if 40% of synthetic colloidal silica 50 weight section is only mixed to the water slurry 100

weight section of 60% of magnesium hydroxides If the No. 1 water glass 2 weight section is added there, it is improvable to the slurry-like water dispersion excellent in a fluidity and stability.

[0011] Moreover, when fuel additive is the emulsion (W/O mold, O/W mold) system of an oil or a water-oil, minute amount addition of the oil solubility alkali-metal salts, such as oil solubility alkali-metal salts, such as petroleum sulfonic-acid sodium, naphthenic-acid sodium, and an octylic acid potassium, or an alkali-metal salt of a part of (D) component mentioned later, etc. may be carried out as this (C) component. As an oil which can be used for the emulsion (W/O mold, O/W mold) system of an oil type, i.e., an oil, or a water-oil, an aliphatic series system and aromatic hydrocarbon, such as kerosene, gas oil, fuel oil A, and a methylnaphthalene, can be illustrated.

[0012] Although the fuel additive of this invention makes water and/or an oil distribute the specified quantity of the (C) component (aforementioned [A]), it adds the (D) surfactant 10 or less % of the weight if needed, and you may make it raise distributed stability more as the presentation rate. Moreover, the (D) surfactant may be used for the purpose of emulsification miscibility with fuel oil, and the improvement in wettability to solid fuel. As a (D) surface active agent used, alkyl allyl compound sulfonates, such as alkylbenzene-sulfonic-acid Na, An alkyl-sulfuric-acid ester salt, polyoxyethylene-alkyl-ether acetate, Dialkyl sulfo succinate, a polyoxyethylene alkyl-sulfuric-acid ester salt, Anionic surface active agents and the polyoxyethylene alkylphenol ether, such as polyoxyethylene alkyl phosphate, Polyoxyethylene fatty acid ester, the polyoxyethylene-alcohols ether, Nonionic surface active agents, such as polyoxyethylene sorbitan fatty acid ester, polyoxyethylene sorbitol fatty acid ester, higher-fatty-acid glycerol ester, polyoxyethylene alkylamine, and an ARUKI roll amide, are illustrated.

[0013] Moreover, coating or permuted Si compound which carried out aluminum denaturation or iron denaturation, especially a silica may be used for the fuel additive of this invention with aluminum compound or Fe compound if needed for Si compound simple substance and/or its whole front face, or a part of the shape of an ultrafine particle with a particle size of 3-200nm.

[0014] Furthermore to the fuel additive of this invention, various combustion failures can be prevented or controlled by adding calcium compound of the shape of powder with a (E) particle size of 0.1-10 micrometers, aluminum compound, Zr compound, etc. 25 or less % of the weight if needed. These (E) components are components supplementary to the aforementioned (A) component, and it is added according to the terms and conditions of the part from which a presentation and combustion conditions of fuel ashes, and slagging are started, and they can use the following powder. calcium compound: A calcium hydroxide, a calcium carbonate, a calcium oxide aluminum compound:aluminum hydroxide, an aluminum oxide Zr compound:zirconium dioxide, zirconium silicate, zircon sand (presentation ZrO266%, SiO233%)

Furthermore, when organic nature, such as methyl cellulose, a carboxymethyl cellulose, a bentonite, and sepiolite, and an inorganic nature thickener may be added and especially particle size uses the (A) component and the (E) component of the shape of large powder, it is effective in sedimentation prevention of powder (coarse grain).

[0015] An aquosity silica sol is explained for an operation of the fuel additive of this invention below at an example. The silica sol used as the aforementioned (B) component is the colloidal silica liquid which made water distribute the ultrafine particle of the silicic acid anhydride of the amount of macromolecules, and the colloidal silica particle has become like drawing 1 . This colloidal silica particle is amorphous, is a real ball-like mostly, and is semipermanently distributed in water in the condition of having been stabilized dramatically. If such a silica sol is intensively added in a combustion furnace, this aggregate is also spherical, with evaporation of moisture, it becomes the aggregate of a very detailed spherical silica particle or a spherical silica particle, those parts adhere to a water pipe furnace wall, and form the thin coat with spherical precise slipping nature which moreover has a mold-release characteristic, and other parts will adhere to the front face of the adhesion particle of combustion ashes, and will reduce ashy adhesiveness. Moreover, the silica (= (B) component) which consists of this spherical ultrafine particle and Mg system [being powdered (coarse grain)], According to making the alkali metal compound (= (C) component) of a minute amount add to the compound (= (A) component) of Si system and Fe system, in high-melting originally An adhesive low spherical silica particle and its adhesive aggregate, And the coarse grain of Mg system, Si system, and Fe system can be made to adhere to a water pipe or a water pipe furnace wall efficiently, the adhesion particle front face of combustion ashes can be made to be able to carry out an adhesion coat efficiently, and other parts can reduce the adhesiveness of fly ash on it. Thus, an alkali metal compound can make the adhesion of a spherical silica particle and the coarse grain of Mg system, Si system, and Fe system it not only becomes easy to adhere to ashes, but raised to the coarse-grain front face of a spherical silica particle front face, its aggregate front face and Mg system, Si system, and Fe system by carrying out minute amount scattering. Moreover, if mean particle diameter of the coarse grain of Mg system which are 20nm and

the (A) component about the mean particle diameter of the spherical silica in the silica sol which is the (B) component, Si system, and Fe system is set to 2 micrometers, since particle diameter differs 100 times, a spherical silica will adhere to the coarse-grain front face of Mg system, Si system, and Fe system, and, as for a part, the particle aggregate of a spherical silica and the coarse grain of Mg system, Si system, and Fe system will adhere. Since adhesion of these fuel additive components can control big and rough-ization by growth to the aggregate of a spherical silica, or the further growth of the spherical silica aggregate, it is effective in only a period until it reaches adhesion ashes at least maintaining the gestalt of the shape of an ultrafine particle of a spherical silica. And if fuel additive is added so much temporarily, the spherical silica in fuel additive can invade into the pore of adhesion ashes, and embrittlement of the whole adhesion ashes can be carried out. If embrittlement advances, fine-particles-ization of a clinker will be attained by refining of the adhesion ashes by the coarse grain of the improvement operation in slipping called the micro bearing effectiveness of a spherical silica particle, Mg system, Si system, and Fe system. Furthermore, a spherical silica particle and its aggregate serve as expansion and porosity, and these spherical silica particles become that it is easy to be destroyed as a whole, when crystallization to a crystalline substance takes place at the temperature of about 1200 degrees C since amorphous, and Na of the hydroxyl group which exists in the water molecule and particle outside of the minute amount incorporated inside a spherical silica particle and its aggregate in this case, and (C) component origin, and K gasify rapidly. the above -- a clinker carries out exfoliation omission simply by a soot blow etc. according to independent thru/or the compounded effectiveness of an operation of these more simply than a water pipe front face and a water pipe furnace wall front face.

[0016] Although the fuel additive of this invention contains the - (C) component (aforementioned [A]), in order that only the (A) component may grind and manufacture a crystalline substance only by the several micrometers quartz particle, particle size distribution of a configuration is greatly irregular like conventional fuel additive. It becomes the aggregate of a mere silica particle, without completing evaporation of moisture easily and quickly, although particle size is large, distribution is also large, when this is intensively added in a combustion furnace, and a configuration is also irregular therefore, and the configuration of a silica particle changing spherically. It does not become porosity in order not to cause expansion, although the reinforcement of the aggregate is weak, but only dilution effect extent of a scale can demonstrate effectiveness, but it is guessed that it does not result by prevention of slagging.

[0017] Moreover, for 5 - 40-% of the weight and (C) component, 0.02 - 2-% of the weight and (D) component is [the (A) component / 10 - 55 % of the weight and (B) component / 10 or less % of the weight and the (E) component] 25 or less % of the weight, and, as for the presentation rate of the fuel additive of this invention containing each component of aforementioned (A) - (E), it is desirable for the remainders to be water and/or an oil.

[0018] It faces using the fuel additive of this invention, and you may add continuously with a fuel, and a fuel line can be made to be able to carry out forcible impregnation, or a service tank can be made to carry out proportion impregnation of the case of liquid fuel. When adding for a solid fuel, especially coal, an additive can be pasted up on a coal particle front face, it can be made to be able to burn, and a clinker front face can be made to vapor-deposit an additive component efficiently by it by adding for the coal on a direct or stoker belt at a stoker, and ground and kneading with a coal mill (mill).

[0019] And bigger effectiveness can be demonstrated by the smaller amount used by devising especially the addition approach. That addition approach is carrying out intermittent abundant addition of the 1 - 50 weight section respectively 1 to 5 times per day as ash content in fuel additive for a short time of 30 minutes - 2 hours to the amount of scattering scales (ash content) 100 weight section at the time of combustion resulting from the ash content contain in the fuel in the fuel additive making time, and the prevention effectiveness of slagging can be raise by leaps and bounds by this addition approach. That is, also in the case of the approach of adding the fuel additive of this invention continuously with a fuel, a clinker can be made into porosity according to the above-mentioned operation, the reinforcement can be reduced, but if a lot of fuel additive is not added, since the lowering on the strength which is like [adhesion ashes can be easily omitted from] cannot be expected, the amount used increases. On the other hand, when intermittent abundant addition of the fuel additive is carried out as mentioned above, while having added fuel additive, strong ashes low enough adhere in the shape of a layer, and while having not added fuel additive, ashes with high reinforcement adhere in the shape of a layer on it. Therefore, even if temporary to some extent thick adhesion ashes are formed, it can be made to drop out with a part for the layer with high reinforcement which was made to exfoliate from a part for a layer with low reinforcement in a self-weight, a soot blow, etc. of the ashes itself, and adhered on it. Since abundant addition is intensively carried out only for a short time by this approach, the amount of the sum total used becomes less than the case where it adds continuously. Therefore, this approach can demonstrate bigger effectiveness

by the smaller amount used.

[0020]

[Example] Example 1 (basic trial)

** Sample offering ash content (clinker)

The clinker generated when burning the Prima charcoal by the dust coal boiler was pulverized, and what passed 200 meshes was used.

** the description of -1 Prima charcoal -- inherent moisture 6.0% ash content 4.4% volatile matter 40.5% fixed carbon 49.1%** -2 clinker (ash content) presentation SiO₂ 55.1%Fe₂O₃ 11.2%aluminum₂O₃ 20.3%CaO 2.8%MgO 3.5% Na₂O 0.8%K₂O 1.3%SO₃ 3.6% -- in addition to this -- 1.4% [0021] ** It considered as solid content, and 5%, it added 10%, mixed churning was fully carried out, and the sample offering additive of ** later mentioned in the sample ashes ground by 200 or less meshes of test methods was considered as the homogeneity presentation, was cast by the molding machine with a diameter height [15mm height of 10mm] in the shape of a cylinder, and was dried at 100 degrees C for 24 hours. Temperature up of the obtained sample was carried out at a rate of 20 degrees C / min with the elevated-temperature heating microscope, observation measurement of softening temperature, the melting point, and the expansion coefficient was carried out, and crushing strength was measured after test termination.

[0022] ** the water slurry ((B) component; -- spherical -- 2= 35% of SiO(s), and (A) component;Mg (OH) -- 2= 15% and (C) component;Na₂O=0.7%) containing a silica sol with a sample offering additive [example 1 of combination] particle size of 10-20nm, and 1% of Mg(OH) No. 2 or 1 water glass with a particle size of 0.3-3 micrometers [the example 2 of combination] -- the water slurry ((B) component; -- spherical -- 2= 20% of SiO(s), 2= 55% of (A) component;SiO(s), and (C) component;Na₂O= 0.03% and K₂O=0.08%) containing a silica sol with a particle size of 15-30nm, SiO₂ with a particle size of 0.5-5 micrometers, and KOH0.1%

[Example 3 of combination] A spherical silica ultrafine particle with a particle size of 20-80nm, Mg with a particle size of 3-8 micrometers (OH) -- the kerosene slurry ((B) component; -- spherical -- 2= 7% of SiO(s), (A) component;Mg (OH)₂=10%, and Fe₂O₃ -- 3= 5%) containing 2, Fe₂O₃ with a particle size of 2-6 micrometers, petroleum sulfonic-acid Na, and alkylbenzene-sulfonic-acid Na (C) -- component; -- Na₂O= 0.3% and 2% of (D) component; surfactants [-- combination -- an example -- four --] -- particle size -- ten - 40 -- nm -- a silica -- a sol -- particle size -- 0.3 - three -- micrometer -- SiO -- two -- particle size -- one - five -- micrometer -- aluminum -- ((OH) --) -- three -- NaOH -- 0.5 - % -- containing -- water -- a slurry ((B) component; -- spherical -- 2= 30% of SiO(s), 2= 10% of (A) component;SiO (s), and (E) component;aluminum (OH) -- 3= 15% and (C) component;Na₂O=1.1%) --

[the example 5 of combination] -- the emulsion mold slurry ((B) component; -- spherical -- 2= 15% of SiO(s), and 4= 30% [2= 20.2% of ZrO(s), 2= 9.8% of SiO(s)] of (E) component;ZrSiO(s)) containing a silica sol with a particle size of 10-35nm, ZrSiO₄ with a particle size of 2-6 micrometers, FeOOH with a particle size of 1-5 micrometers, 1.5% of No. 3 water glass, polyoxyethylene fatty acid ester, and fuel oil A

(A) component; -- FeOOH=10% and (C) component;Na₂O= 0.5% and 5% of (D) component; surfactants

[Example 1 of a comparison] Water slurry of a silica with a particle size of 1-5 micrometers (30% as SiO₂ concentration)

[Example 2 of a comparison] Water slurry of a magnesium hydroxide with a particle size of 1-5 micrometers (40% as Mg(OH)₂ concentration)

[Example 3 of a comparison] Water slurry of a calcium hydroxide with a particle size of 1-5 micrometers (35% as calcium(OH)₂ concentration)

[Blank]

Additive-free [0023] ** Test result [a table 1]

*1) *2)

測定項目 添加量		軟化点 (℃)	融点 (℃)	膨張率 (%)	圧潰強度 (kg)
配合例 1	5%	1250	1300	138	10.1
	10%	1320	1350	186	3.5
配合例 2	5%	1260	1310	125	11.2
	10%	1320	1360	152	4.5
配合例 3	5%	1240	1285	113	12.0
	10%	1305	1340	149	4.4
配合例 4	5%	1265	1320	132	10.6
	10%	1330	1390	177	3.9
配合例 5	5%	1245	1295	125	11.1
	10%	1310	1350	158	4.3
比較例 1	5%	1240	1250	106	15.0
	10%	1250	1260	111	14.1
比較例 2	5%	1200	1210	101	17.1
	10%	1160	1170	102	17.8
比較例 3	5%	1190	1200	103	16.9
	10%	1160	1190	103	18.3
ブランク	0%	1210	1250	103	19.8

* 1) 熱膨張率は昇温開始前の容積を100%とし、

1000℃の加熱状態における容積を表した。

* 2) 圧潰強度は融点測定後の試料を

木屋式デジタル硬度計 (KHT-20型) にて測定した。

[0024] ** The examples 1-5 of combination concerning consideration 1. this invention appeared notably, when lifting of softening temperature and the melting point was remarkable and it was especially a high addition compared with the examples 1-3 of a comparison, and a blank.

2. The expansion coefficient was large similarly and it excelled compared with the examples 1-3 of a comparison, and a blank. The expansion coefficient became 1.5 to 1.9 times, and especially the thing of the high addition of the examples 1-5 of combination showed the very big value.

3. The examples 1-5 of combination showed the value with very small crushing strength compared with the examples 1-3 of a comparison, and a blank.

4. The expansion coefficient of ash content is large, the ashes of the examples 1-5 of combination are porosity, and that crushing strength is small means that it is moreover easy to break.

[0025] Example 2 (trial by the real unit)

** a boiler specification and type; -- the course mold dust coal boiler by Mitsubishi Heavy Industries, LTD., and evaporation; -- 350 T/H and working pressure; -- 13.7MPa and amount of coal used; -- 800t/day and ventilation method; -- a balanced draft and mill (coal mill); -- three sets (roller mill)

[0026] ** The burner used for the schematic-diagram experiment of a real unit was shown in drawing 2. the inside of drawing and 1 -- a coal bunker and 2 -- a feed machine and 3 -- a mill (grinder) and 4 -- Blois for conveyance, and 5 -- a chemical perfusion pump and 6 -- an additive tank and 7 -- a secondary superheater and 8 -- the 3rd superheater and 9 -- a primary superheater and 10 -- an economizer and 11 -- a burner and 12 -- an air heater and 13 -- EP (electrostatic precipitator) and 14 -- water seal opening and 15 -- ashes picking -- service water -- it is a tank. [in addition]

Moreover, a white arrow head shows the flow of exhaust air, and a black arrow head shows the ashes which fall in a soot blow etc.

[0027] ** The test-method ** -1 outline book real unit was the Prima charcoal single-fuel fired boiler, and since it was checked by the observation from an inspection hole that a huge clinker is formed in a furnace wall burner lower zone in a blank trial in about one month, the duration of test was set up in one month.

** The additive of the example 1 of combination in -2 sample-offering additive example 1 and the example 1 of a comparison was used.

** It added for the coal on the stoker belt before [impregnation location mill] -3 additive.

** About the additive of the example 1 of the addition approach combination of -4 additive, intermittent impregnation was carried out as an additive ash content ($\text{SiO}_2 + \text{Na}_2\text{O} + \text{MgO}$) equivalent to 10% of the ash content in the coal for a bis die, 2 hours each, and 2 hours each. About the additive of the example 1 of a comparison, continuation impregnation of 1/1000 of the amounts of coal samples was carried out in the first half (half moon).

[0028] ** The charge of trial item ** -1 sample offering; it will be 1 time [0029] on bottom product clinker ** -2 trial item; weight, crushing strength, and apparent-specific-gravity ** -3 measurement gap; the 3rd through which it will be run from a water seal opening lower ashes picking tank. ** Weight change of a test-result ** -1 bottom-product clinker (t / three days)

[A table 2]

	比較例 1	配合例 1
1	10.2	10.2
2	10.3	10.3
3	9.8	10.4
4	9.4	10.2
5	8.7	9.8
6	8.6	10.3
7	8.4	10.0
8	7.6	9.9
9	7.3	10.1
10	6.7	10.0
平均	8.70	10.12

the case where the additive of the example 1 of a comparison is added to being an almost fixed value for one month when the additive of the example 1 of combination is added although about 10% of coal ash is generally collected as a clinker -- about the 9th (at time of the 3rd measurement) day -- from -- it fell gradually and was falling rapidly the second half. Although the 14.2t (10.12-8.70) ($\times 10=$) difference came out in one month in the example 1 of combination, and the example 1 of a comparison, when the huge clinker had deposited on the furnace water seal opening upper part in the case of the example 1 of a comparison, the exfoliation omission of the clinker after a boiler halt were carried out and the weight was measured also in visual observation, it is about 15t and the weight difference of a bottom product clinker was coincided with.

[0030] ** It is measurement [a table 3] of apparent specific gravity about the crushing strength of -2 bottom-product clinker.

	比較例 1		配合例 1	
	圧潰強度 (kg)	見掛け比重	圧潰強度 (kg)	見掛け比重
1	16.4	2.27	4.8	1.17
2	15.9	2.23	5.3	1.20
3	17.6	2.18	5.2	1.20
4	16.6	2.21	4.6	1.14
5	15.9	2.30	4.8	1.15
6	16.6	2.29	4.8	1.15
7	17.5	2.29	5.2	1.18
8	17.9	2.22	5.2	1.16
9	18.1	2.26	5.3	1.22
10	19.0	2.23	4.8	1.15
平均	17.15	2.25	5.00	1.17

When calculated from the average, the example 1 of combination was falling 48% by credit specific gravity compared with the example 1 of a comparison, and buildup of a soot blow etc. of voidage, i.e., porosity-ize, become easy to break and exfoliation omission are carried out simply, was found by combustion coal ash.

[0031] unless the configuration which this invention is not limited to said example carried out, and was indicated to the claim although this invention was explained based on the example above is changed -- how -- also coming out -- it can carry out.

[0032]

[Effect of the Invention] In combustion of a fuel with many [as explained above] mineral constituent (ash content) contents to which the fuel additive of this invention makes representation various fuels, especially a coal fired boiler When description of the clinker which generates the slagging failure resulting from the ash content in a fuel was made into porosity, crushing strength can be reduced and intermittent abundant addition especially of the fuel additive of this invention is carried out While being able to demonstrate bigger effectiveness by the smaller amount used, carrying out exfoliation omission more easily than a furnace wall front face or a water pipe, preventing adhesion ashes and preventing high and dew point corrosion further, generation of unburnt carbon, and SO₃ and NO_x can be controlled.

[Translation done.]